

Shearing – Course: Technique of Working Sheet Metals, Pipes and Sections. Methodical Guide for Instructors

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Shearing – Course: Technique of Working Sheet Metals, Pipes and Sections. Methodical Guide for Instructors

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1. Objectives and Subject Matters of Vocational Training in Shearing Techniques

After having terminated the training, the trainees are to surely master the most common techniques of “shearing”.

For that purpose, the following objectives will have to be attained:

Objectives

- The trainees will have acquired profound knowledge about types and working means for shearing.
- They will know how to master the different techniques used in shearing sheet metals and sections with various tools and machines.
- They will have been enabled to select the appropriate tool as to sheet thickness and way of cut.
- The trainees will know how to apply tools and machinery, while considering the health protection, labour safety and fire precaution measures.
- They will know how to assess the quality of their work.

To achieve the aims required, the instructor has to impart the following subject matters:

Subject Matters

Knowledge

- Purpose of shearing
- Types and fields of application of tools and machinery
- General construction of shears
- Operating characteristics and techniques of shearing
- Process routines of shearing
- Instructions on labor safety

Abilities

- Knowing how to operate mechanical shears and special machines to shear sheet metals and sections.

2. Organizational Preparations

To ensure a trouble-free course of instructions, exercises and teaching, it is necessary to organize a well-prepared training. For that purpose, the following measures are indispensable.

2.1. Planning the Training in Shearing Techniques

Proceeding from the entire hour volume, the times for the individual training sections of this didactic unit should be planned in a differentiated manner.

It is recommended to make a time schedule for the following training sections:

- for introduction in the techniques in the form of instruction
- for demonstrations required
- for instructions related to task in preparing the exercises
- for executing the exercises
- for recapitulations and controls

In planning the time schedule, the following factors are to be taken into consideration additionally:

- Trainees' present state of education
- Conditions of training
- Trainees' future employment
- Degree of difficulty of the training section

Key point of any training section is always the acquisition of skilled abilities and facilities to be acquired by exercises. The largest period of time should be allocated to them.

2.2. Preparing the Instructions on Labour Safety

Before the exercises start, a brief instruction should be given, comprising the proper handling of working means and recommendations as to avoiding accidents during work.

The following key points have to be stressed particularly:

- Use gloves when transporting large sheet plates – risk of getting injured.
- Only use sharp shears being in working order – blade clearance must be correctly set.
- Do not work with your hands between the shear blades – risk of getting injured.
- Hand-lever shears and plate shears to be operated by one person only. As for larger sheet metals and long sections, a second person may help shove the material trough from the side.
- Correctly adjust the toe dog when working with lever shears and shearing machines.
- Do not stay within the swivel range of hand lever during the shearing operation.
- After finishing shearing on the hand-level shear, secure hand lever against dropping.
- Shear steel sections with section knives only.

- Only operate shearing machines after being instructed comprehensively. Observe the manufacturer’s operating instructions exactly.
- At once, throw waste material into the waste container after shearing operation.

After being instructed, the trainees have to confirm above recommendations with their signature in the control book.

2.3. Providing the Teaching Aids

- The “Trainees’ Handbook of Lessons – Shearing” will be distributed among the trainees according to their number.
- Essential illustrations from the “Trainees’ Handbook of Lessons” should be used as visual aids (e.g. as pictures on flip charts, blockboards etc.).
- Workpieces that are sawed, chiseled or sheared should be provided as visual aids.
- Special tools the trainees do not know yet should be used as visual aids as well, as far as they can be transported.
- If transparencies on shearing are available, they should be included in the instruction in any case.

2.4. Providing the Working Means

- The “Instruction Examples for Practical Vocational Training – Shearing” as a theoretical basis for the exercises to be carried out are to be distributed among the trainees as to their number.
- The unmachined materials required for the exercises are to be prepared and made available in a sufficient quantity, using the given material stated in the “Instruction Examples for Practical Vocational Training”.
- Check the workshop’s complete outfit with tools, machines, measuring and testing means as well as auxiliaries according to the planned exercises.
- Recommended basic outfit
 - Steel scribe, beam trammels, smooth files and bastard cut files
 - Engineer’s hammer, aluminium hammer
 - Steel rule, caliper gauge
 - Tinners’ snip, tinners’ through snip
 - Curve shear, plate shear, hand–lever shear
 - Vise, surface plate
- Check serviceability of machines to be employed for shearing operation, considering labour safety regulations before the exercises begin.

3. Recommendations Regarding Execution of Vocational Training in Shearing Techniques

The following sections contain proposals on how to arrange the trainees’ instruction, the demonstration of the techniques as well as exercises and controls.

3.1. Introductory Instruction

The introductory instruction should be performed with the trainees in a class-room, if possible. During the instructions, attention has to be paid to the trainees' noting down necessary supplements or replies to questions in the "Trainees' Handbook of Lessons". With regard to the key points contained in the "Trainees' Handbook of Lessons" the instruction can be given as to the following subject matters.

Purpose of Shearing

At the beginning of instruction it is necessary to explain to the trainees the purpose of shearing compared to other cutting procedures – such as sawing and chiseling. In this connection, the advantages of shearing have to be clearly presented. A brief demonstration may support this fact.

3 trainees are to cut a sheet metal of 2 mm thickness (length and width of about 50 mm) into two halves.

These trainees receive the following tools and auxiliaries:

- 1st trainee – hand-type hack saw, vise
- 2nd trainee – flat chisel, engineer's hammer, surface plate
- 3rd trainee – hand-lever shear

The other trainees have the following observation tasks:

- Time expenditure starting from setting the tool up to the cut sheet metal
- Comparing force consumption
- Assessing accuracy to size on scribed line
- Assessing expenditure for re-work due to the appearance of cutting line.

If this demonstration cannot be conducted in the class-room, it should be effected – in any way – in the workshop before the exercise starts. In this case, the prepared demonstration workpieces should be shown during the instruction.

Tools and Machines

The following common shears are to be introduced in groups. Shears available in the workshop should be used as visual aid in this connection:

- Tinnern's snip, tinnern's through snip, hole cutting shear
- Curve shear, plate shear, hand-lever shear
- Cutting tools
- Roller shear, electric hand-lever shear
- Hammer shear machine.

The explanations concerning these tools and machines must contain the characteristic features of these working means, the special possibilities of employment and their functional principles.

Subsequently, the trainees should be in the position to select the most favourable shear when a certain work-piece to be sheared is mentioned after knowing the thickness of material as well as form and length of cut.

The trainees should ask a few questions about this key point – for instance:

"With which shear is it most favourable to cut a circular disk out of a 3 mm thick sheet-metal plate?" Following this question-answer talk the trainees should solve in writing the respective task contained in the "Trainees' Handbook of Lessons".

General Construction of Shears

With the help of a blackboard drawing as to "Figure 12" of the "Trainees' Handbook of Lessons" the angles and the blade clearance on shears can be descriptively explained now. It is necessary that the trainees know about the general construction of shears in order to be able to assess the serviceability of shears entrusted to them in the workshop and, if required, to perform minor adjustments or repairs of these working means.

Mode of Operation of Shears

The 3 stages of the shearing process should be briefly explained, while using figures 17 to 20 of the "Trainees' Handbook of Lessons" for drawing a panel sketch.

With the help of the joint face appearance, the trainees should be explicated the necessity of minor re-work (de-burring). It should be stressed that sheared material edges would be very sharp and may therefore cause injuries.

Shearing Techniques

The techniques – cutting-in, cutting-off, cutting-out and punching – are to be described in a general account in order to elucidate the differences of possible ways of cut

Selected Technological Sequences of Shearing

Since the shearing process has a very simple work sequence, it is only necessary in this connection to demonstrate the handling of the shear in combination with the material to be cut. It should be particularly referred to the exact scribing, the correct alignment of the workpiece between the shear blades and to the observance of the right way of cut.

The following exemplary sequence will be described in the "Trainees' Handbook of Lessons":

1. Cutting in sheet metal with the tinner's snip
2. Cutting off sheet metal with the hand-lever shear
3. Cutting off angular section with the hand-lever shear

With the help of these examples it is very clearly explained which particularities have to be noted when sheets and sections are scribed and cut.

Hints on Labour Safety

During the shearing operation, incised wounds may occur very quickly, which can only be avoided by exactly observing the hints on labour safety and the regulations on how to operate tools and machines.

The essential hints on labour safety are contained in the "Trainees' Handbook of Lessons" – they should be given very urgently.

3.2. Practical Exercises

Basically, the necessary hints on labour safety have to be given prior to the exercises.

Subsequently, the trainees receive their workplaces and the equipment available in the workshop will be checked as to its serviceability.

It is recommended to start any exercise with a demonstration by the instructor in connection with an instruction related to the didactic example. Here, the trainees should be motivated to perform the exercises in good quality. Difficulties to be expected should be indicated. At the same time, rating key points are to be made known.

It is necessary that the instructor performs the exercise himself before.
Only in this way does he know the difficulties arising during the operation.

The course of exercises may be effected in the sequence of the instruction examples proposed.

With the help of the "Instruction Examples for Practical Vocational Training" 5 exercises can be carried out by using various tools. For that purpose, a list of materials (unmachined material, tools, measuring and testing instruments as well as auxiliaries), the work routine to carry out exercises and a descriptive work drawing are contained in the documentation "Instruction Examples...". Thus, the trainees attain all the information required to implement the exercises purposefully.

To give a survey which practical pieces the knowledge previously imparted is to be applied to, the individual instruction examples will be briefly described hereinafter.

Instruction Examples

Instruction example 13.1. Smother and putty knife

The sheet-metal parts for a smother and a putty knife are to be cut out with the thinners' snip and the tinners' through snip. (Figure 1)

Instruction example 13.2. Roof tiler trowel

Sheet parts for two different roof tiler trowels are to be cut out with the curve shear. (Figure 2)

Instruction example 13.3. Smoothing trowel

The sheet part for a smoothing trowel is to be cut out with the mechanical plate shear. (Figure 3)

Instruction example 13.4. Brick trowel

The sheet part for a brick trowel is to be cut out with the hand-lever shear. (Figure 4)

Instruction example 13.5. Hinge-joint

Respectively an angle, a round and a flat are cut to length with the section blades of the hand-lever shear. (Figure 5)

All the trainees may carry out the exercises at the same time, if the material prerequisites have been ensured (availability of sufficient working means).

In this case, the trainees can do each exercise individually and each trainee should have so much time as he would need. If there are not enough working means available, the trainees must be grouped, considering to be favourable to group them as to the use of the different tools.

Should the proposed instruction examples not be used for exercising, it is also possible to choose other practical pieces. Here, it should be noted that all the techniques previously talked about could also be exercised on these practical pieces.

Key Points of Practical Work

To execute the practical work it is recommendable to stipulate key points of observation and rating. They may be distinguished by the following criteria:

- Do the trainees prepare their workplaces carefully?
- Are the mentioned tools placed ready and checked as to their serviceability?
- Are the workpieces scribed exactly?
- Do the trainees achieve the quality features required?

Particularly:

- Is the line of cut exactly on the scribed line?
 - Can transverse cracks and shoulders be seen at the line of cut?
 - Is the workpiece presented for control in a straightened and de-burred state?
 - Are the workpieces accurate to size?
-
- Do the trainees apply the appropriate test method?
 - Are the trainees able to correctly assess the quality of their work themselves?
 - Are the trainees observing the labour safety regulations?

3.3. Examples for Recapitulation and Control

Tasks have been compiled in this section to strengthen and revise knowledge and abilities acquired so far. Tasks also contained in the "Trainees' Handbook of Lessons" have been marked with the letter "A".

1. What is the purpose of shearing?

"A" (*Sheet metals and sections are cut in a non-chip, straight-lined or curve-shaped way.*)

2. Which are the advantages of shearing compared to sawing?

"A" (*No metal is removed from the material by cutting, the scribed line can be exactly followed, joint faces require little re-work, shearing process is fast, way of cut may be straight-lined or curve-shaped.*)

3. How are shearing techniques differentiated?

"A" (*cutting in, cutting off, cutting out, punching*)

4. Which cuts can be made with the tinner's snip?

"A" (*Short straight-lined and short curve-shaped cuts on thin sheet metals.*)

5. For which cuts is the tinner's through snip employed?

"A" (*Straight longer cuts on thin sheets.*)

6. For which cuts is the curve shear employed?

"A" (*Circular and curve-shaped cuts on thin and medium-thick sheets.*)

7. For which cuts is the plate shear used?

"A" (*Long cuts on thin sheets.*)

8. For which cuts is the hand-lever shear used?

"A" (*Short straight-lined and curve-shaped cuts on medium-thick sheets and sections.*)

9. Why have the shear knives a great wedge angle?

"A" (*So that they are sufficiently stable and the blade edges do not break out so quickly.*)

10. Why is it necessary to keep a blade clearance?

"A" (*So that the blade edges do not rub on each other and get dull.*)

11. What will happen when too great a blade clearance has been adjusted?

"A" (*The sheet will be bent off during the shearing operation.*)

12. What is the task of the dog on the lever-type shear and shearing machine?

"A" (*Keeping the sheet metal in horizontal position to avoid pitching down.*)

13. Why is an aperture angle of 15° important during the shearing process?

"A" (*To prevent the workpiece from being pushed out of the shear.*)

14. In which stages is the shearing process performed?

"A" (*Notching, cutting and tearing*)

15. What is the difference between the cutting–out and punching techniques?

“A” (*Cutting–out – material being cut out is the workpiece; Punching – material being punched is scrap.*)

16. What is to be expected in the sheet when the shear knives are completely closed?

“A” (*Transverse cracks develop at the end of cut.*)

17. Why is the scrap side of a sheet to be situated on the right–hand side?

“A” (*On shearing, the upper shear knife presses the right–hand sheet part downwards, cuts bends or twists it.*)

18. Why must steel sections be cut in section knives?

“A” (*Section knives are adapted to the steel section and make a clean shearing possible. They are more stable than plane shear blades.*)

19. What will happen when steel sections are cut on plane shear blades?

“A” (*Cutting edges break out.*)

20. Why must the hand lever be arrested on the hand–lever shear after the shearing operation?

“A” (*Because it may fall down – risk of getting injured.*)

21. Why must the rendered waste material be thrown in the waste container immediately?

“A” (*Because the cutting residues have been bent and are very sharp–edged – risk of getting injured.*)